

32. (NEW) The device of claim 23, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 15 to approximately 30 minutes.

33. (NEW) The device of claim 23, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 20 minutes.

#### **REMARKS**

Claims 1-27 are pending in the present application and all claims have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Konuma in view of Watkins *et al.* (hereinafter Watkins) and Itoh *et al.* (hereinafter Itoh). Applicant respectfully requests reconsideration by the Examiner in view of the following remarks.

Independent claims 1 and 9 have been cancelled. Dependent claims 4 and 11 have been rewritten in independent form, explicitly including at least the limitations of the cancelled claims 1 and 9. New claims 28-29, 30-31, and 32-33 depending from claims 4, 11, and 23, respectively, have been added. As rewritten, independent claims 4 and 11 of the present application are directed to a method of manufacturing a field emission device comprising operating the field emission device for at least approximately 15 minutes at a pressure of at most about  $10^{-8}$  Torr to evacuate outgassed materials, and sealing the field emission device. Independent claims 15 and 21 have also been cancelled, and dependent claims 17 and 23 have been rewritten in independent form, explicitly including at least the limitations of the cancelled claims 15 and 21. As rewritten,

independent claims 15 and 21 in the present application are directed to a field emission device formed by a method comprising operating the field emission device at a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes to evacuate outgassed materials and then sealing the field emission device.

As explained in the specification, operating the field emission device results in certain materials outgassing from the anode of the device. If these outgassed materials are allowed to remain in the field emission device, they can contaminate and reduce the efficiency of the cathode element. While operating the field emission device at a sufficiently reduced pressure, the outgassed materials can be evacuated from the device before they are allowed to contaminate the cathode element. Following removal of much of this material, the field emission device can then be sealed. The result is a device with increased life and greater current stability. As pointed out by the Applicant on page 8, lines 11-16, of the present application, in one embodiment of the present invention, the field emission device was operated without observable tip degradation after running for many hours, even at high pressures. In contrast, conventionally manufactured field emission devices running under standard conditions of about  $10^{-5}$  Torr to about  $10^{-6}$  Torr may show severe tip degradation after running for less than 100 hours.

Konuma seeks to clean the cathode element of a cathode ray tube and to enhance the level of a vacuum in a cathode ray tube through the use of a getter in the tube. Konuma heats the getter material, and gas is emitted from the getter. A voltage is applied to the cathode and the cathode cone to cause electrons to be emitted. These electrons collide with the gases from the getter, the gases are ionized, and the ions bombard the cathode to clean that element. Following this sputtering of the cathode, the tube is sealed, and the gettering continues to enhance the level of vacuum in the sealed CRT. Konuma is concerned with cleaning the cathode rather than

operating a device so as to allow normal outgassing of materials from the anode to occur. In fact, Konuma does not address the issue of materials outgassed from the anode during normal operation of the CRT. Consequently, Konuma simply discloses applying a voltage to the cathode and the cathode cone for 30 seconds while the pressure within the sealed CRT "is in the range of  $1 \times 10^{-9}$  Torr or more and  $1 \times 10^{-7}$  Torr or less." See Konuma, col. 7, ll. 1-2.

Itoh utilizes a process of introducing a reducing gas into the display device, holding the reducing gas in the display device for several minutes, and then evacuating the display device to about  $10^{-5}$  Torr. After several repetitions of this process, the pressure is reduced to about  $1 \times 10^{-7}$  Torr and the tube is sealed. See Itoh, col. 5, ll.14-17. As noted by the Examiner, Itoh also mentions activating the "electron emitting means" while subjecting the display device to baking. However, Itoh suggest that a process of simply activating the device while evacuating the tube "fail[s] to sufficiently discharge gas from the display device." See Itoh, col. 2, ll.-39-42. As thus understood, it is respectfully submitted that independent claims 4, 11, 17, and 23 are allowable over the prior art.

To establish a *prima facie* case that the present invention is obvious over Konuma in view of Itoh and Watkins, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings in the manner suggested by the Examiner. That is, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. No such suggestion or motivation is found in the prior art cited by the Examiner. Although the problem of tip degradation is well known in the art, Konuma is not directed to preventing or reducing the effects of tip degradation in display devices. Konuma is merely concerned with cleaning the cathode and thus Konuma only discloses

applying a voltage to the cathode and the cathode cone for 30 seconds while the pressure within the sealed CRT "is in the range of  $1 \times 10^{-9}$  Torr or more and  $1 \times 10^{-7}$  Torr or less." See Konuma, col. 7, ll. 1-2. There is no suggestion in Konuma to operate the field emission device at a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes to evacuate outgassed materials before sealing the field emission device.

Nor is there any suggestion or motivation in Itoh for combining the elements in the manner suggested by the Examiner. Itoh discusses a method for removing potentially contaminating gases from a CRT. As acknowledged by the Examiner, Itoh clearly states that the process of simply activating the device while evacuating the tube "fail[s] to sufficiently discharge gas from the display device [and] thereby fail[s] to significantly improve the life characteristics of the display device." See Itoh, col. 2, ll. 39-42. Thus, Itoh teaches that contaminants should instead be removed using a process of introducing a reducing gas into the display device and then evacuating the display device at a pressure of about  $10^{-5}$  Torr, *i.e.* Itoh teaches evacuating contaminating gas at a higher pressure and without operating the device. See Itoh, col. 2, ll. 49-57. Thus, Itoh clearly teaches away from the claimed method.

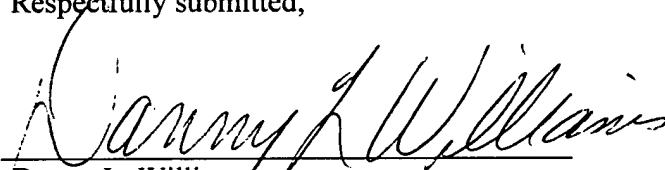
The Examiner relies on Watkins for a teaching that a display device should be held in an atmosphere of  $10^{-8}$  Torr for 1-2 hours prior to sealing in order to remove water and other contaminants. The Examiner asserts this teaching would be combined, by a person of ordinary skill, with Konuma or Itoh to realize a method of operating the device at a pressure of  $10^{-8}$  Torr or less for at least approximately 15 minutes. However, there is no suggestion or teaching in Watkins to operate the display device in an atmosphere of  $10^{-8}$  Torr for 1-2 hours prior to sealing in order to remove water and other contaminants. In particular, there is no suggestion or teaching in Watkins that operating the device at a pressure of at most  $10^{-8}$  Torr or less for at least

approximately 15 minutes would remove outgassed materials to such an extent that tip degradation may be reduced, resulting in increased life and greater current stability in the display. In fact, as noted by the Examiner and discussed above, the only prior art reference to consider the possibility of operating the device while evacuating the device (Itoh) clearly states that use of this process is not sufficient to satisfactorily evacuate contaminant materials and instead suggests operating the device while evacuating the device at about  $10^{-5}$  Torr, *i.e.* Itoh teaches evacuating contaminating gas at a higher pressure. Hence, Itoh teaches away from the claimed method, and the person of ordinary skill in the art should not be expected to go against such suggestion without benefit of Applicant's disclosure. Thus, it is respectfully submitted that independent claims 4, 11, 17, 23, and all claims depending therefrom are allowable over Konuma in view of Itoh and Watkins.

Applicant respectfully requests reconsideration by the Examiner of his rejections of claims 1-27 and favorable consideration of new claims 28-33. If the Examiner has any questions or comments, or if a telephone conference would facilitate disposition of this case, he is encouraged to contact the undersigned by telephone at (713) 934-4060.

Respectfully submitted,

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**COPY OF AMENDED CLAIMS FOR SERIAL NO. 09/386,972**

1. (CANCELLED) A method of manufacturing a field emission device, the method comprising:

operating the field emission device in a pressure of at most about  $10^{-8}$  Torr for a selected period of time to evacuate outgassed materials; and  
sealing the field emission device.

2. (AMENDED) The method of claim [1] 4, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr includes operating the field emission device in a pressure of approximately  $10^{-8}$  Torr.

3. (CANCELLED) The method of claim 1, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr for a selected period of time includes operating the field emission device for approximately 20 minutes.

4. (AMENDED) [The method of claim 1, wherein operating the field emission device in the pressure of approximately  $10^{-8}$  Torr for the selected period of time includes operating the field emission device] A method of manufacturing a field emission device, the method comprising:  
operating the field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes [a period of time sufficient] to remove at least a portion of materials from within said field emission device; and  
sealing the field emission device.

5. (AMENDED) The method of claim [1] 4, the method further including:  
sealing the field emission device after the [selected] at least approximately 15 minutes.
6. (AMENDED) The method of claim 5, wherein sealing the field emission device after the  
[selected period of time] at least approximately 15 minutes includes sealing the field emission  
device in a vacuum chamber.
7. (AMENDED) The method of claim 5, wherein sealing the field emission device after the  
[selected period of time] at least approximately 15 minutes includes sealing the field emission  
device in atmospheric pressure.
8. (CANCELLED) The method of claim [4] 3, the method further including:  
sealing the field emission device after the selected period of time.
9. (CANCELLED) A method of manufacturing a field emission device, the method  
comprising:  
cleaning a base plate of the field emission device, the base plate having an opening  
formed therein;  
assembling the base plate with a face plate of the field emission device;  
sealing the assembled base plate and face plate of the field emission device; and

operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for a selected period of time to evacuate outgassed materials through the opening before sealing off the field emission device completely.

10. (AMENDED) The method of claim [9] 11, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr includes operating the field emission device in a pressure of approximately  $10^{-8}$  Torr.

11. (AMENDED) [The method of claim 9, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr for the selected period of time includes operating the field emission device for approximately 20 minutes.] A method of manufacturing a field emission device, the method comprising:

cleaning a base plate of the field emission device, the base plate having an opening formed therein;

assembling the base plate with a face plate of the field emission device;

sealing the assembled base plate and face plate of the field emission device; and

operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes to remove at least a portion of outgassed materials through the opening before sealing off the field emission device completely.

12. (CANCELLED) The method of claim 9, wherein operating the field emission device in the pressure of approximately  $10^{-8}$  Torr for the selected period of time includes operating the



field emission device for a period of time sufficient to remove at least a portion of materials from within said field emission device.

13. (AMENDED) The method of claim [9] 11, wherein sealing off the field emission device completely includes sealing the field emission device in a vacuum chamber.

14. (AMENDED) The method of claim [9] 11, wherein sealing off the field emission device completely includes sealing the field emission device in atmospheric pressure.

15. (CANCELLED) A field emission device formed by a method comprising:  
operating the field emission device in a pressure of at most about  $10^{-8}$  Torr for a selected period of time to evacuate outgassed materials through a tube before pinching off the tube to seal the field emission device.

16. (AMENDED) The device of claim [15] 17, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr includes operating the field emission device in a pressure of approximately  $10^{-8}$  Torr.

17. (AMENDED) [The device of claim 15, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr for the selected period of time includes operating the field emission device for approximately 20 minutes] A field emission device formed by a method comprising:

operating the field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes to remove at least a portion of outgassed materials through a tube before pinching off the tube to seal the field emission device.

18. (CANCELLED) The device of claim 15, wherein operating the field emission device in the pressure of approximately  $10^{-8}$  Torr for the selected period of time includes operating the field emission device for a period of time sufficient to remove at least a portion of materials from within said field emission device.

19. (AMENDED) The device of claim [15] 17, wherein pinching off the tube to seal the field emission device after the [selected period of time] at least approximately 15 minutes includes pinching off the tube in a vacuum chamber.

20. (AMENDED) The device of claim [15] 17, wherein pinching off the tube to seal the field emission device after the [selected period of time] at least approximately 15 minutes includes pinching off the tube in atmospheric pressure.

21. (CANCELLED) A field emission device formed by a method comprising:  
cleaning a base plate of the field emission device, the base plate having an opening for a tube;  
assembling the base plate with a face plate of the field emission device;  
sealing the assembled base plate and face plate of the field emission device; and

operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for a selected period of time to evacuate outgassed materials through the tube before pinching off the tube to seal off the field emission device completely.

22. (AMENDED) The device of claim [21] 23, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr includes operating the field emission device in a pressure of approximately  $10^{-8}$  Torr.

23. (AMENDED) [The device of claim 21, wherein operating the field emission device in the pressure of at most about  $10^{-8}$  Torr for the selected period of time includes operating the field emission device for approximately 20 minutes] A field emission device formed by a method comprising:

cleaning a base plate of the field emission device, the base plate having an opening for a tube;

assembling the base plate with a face plate of the field emission device;

sealing the assembled base plate and face plate of the field emission device; and

operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes to remove at least a portion of outgassed materials from within said field emission device.

24. (CANCELLED) The device of claim 21, wherein operating the field emission device in the pressure of approximately  $10^{-8}$  Torr for the selected period of time includes operating the

field emission device for a period of time sufficient to remove at least a portion of materials from within said field emission device.

25. (AMENDED) The device of claim [21] 23, the method further including pinching off the tube to seal off the field emission device completely after the [selected period of time] at least approximately 15 minutes.

26. (AMENDED) The device of claim 25, wherein pinching off the tube to seal off the field emission device completely after the [selected period of time] at least approximately 15 minutes includes pinching off the tube in a vacuum chamber.

27. (AMENDED) The device of claim 25, wherein pinching off the tube to seal off the field emission device completely after the [selected period of time] at least approximately 15 minutes includes pinching off the tube in atmospheric pressure.

28. (NEW) The method of claim 4, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 15 to approximately 30 minutes.

29. (NEW) The method of claim 4, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the

sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 20 minutes.

30. (NEW) The method of claim 11, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 15 to approximately 30 minutes.

31. (NEW) The method of claim 11, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 20 minutes.

32. (NEW) The device of claim 23, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 15 to approximately 30 minutes.

33. (NEW) The device of claim 23, wherein operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for at least approximately 15 minutes includes operating the sealed field emission device in a pressure of at most about  $10^{-8}$  Torr for approximately 20 minutes.